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CHEMICAL POSITIONS IN THE GOVERNMENT SERVICE¹

WHEN we enter the profession of chemistry our chief interest is centered on the conditions that obtain in the various fields of chemical activity. In the case of those who retain their youth by contact with student life, that interest does not lessen.

Frequent inquiries covering a broad scope are made by students and recent graduates in chemistry, and teachers, to whom they naturally turn for advice, are constantly asking for material that will enable them to supply this information. Inquiries made at the Department of Agriculture regarding opportunities for chemical work are mainly from students who are nearing the completion of their college course, or from teachers who are directing the studies of others. Often the inquiry relates to the character of work which the student should undertake in order to fit himself for a position in the department. Unfortunately the information is rarely sought with a view to increasing the equipment of men who have received broad fundamental training. The purpose is usually to substitute for a portion of a regular course in chemistry, some special study that will afford a temporary advantage.

I offer these inquiries as my apology for discussing in a few minutes a subject that would require a volume for its adequate treatment. It is my purpose to

¹Address before Section C of the American Association for the Advancement of Science, Chicago, January 2, 1908.

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

discuss very briefly the nature of the work done in those laboratories of the various departments of the federal government to which appointments are made with some frequency. I shall consider the subject only from the standpoint of the opportunities of the chemist seeking a position and shall not include those laboratories to which appointments are rarely made.

In 1885 this subject was discussed by Professor F. W. Clarke in his address as retiring president of the Chemical Society of Washington—now the Washington Section of the American Chemical Society.² The following quotation from his address is of much historic interest:

My first visit to Washington was in the autumn of 1873. At that time chemistry had gained but a precarious foothold in the public work. In the agricultural department, one chemist, McMurtrie, sometimes with and often without an assistant, occupied a small laboratory, and carried forward his investigations with very slender resources. At the Smithsonian Institution, Dr. Endlich, then in charge of the mineral collections, attended to general chemistry routine and made occasional assays. Then, as now, the speculative constituent tormented his member of congress and the institution with ores taken from granite boulders; with fossils to be assayed for silver or tin; with iron pyrites rich in imaginary gold, or with alleged coal which proved to be nothing but black tourmaline. With such trivialities the time of the chemist was often frittered away, to the detriment of science and the benefit of nobody. In a basement room of the Smithsonian, dimly lighted and badly ventilated, Dr. Loew, with few reagents or appliances, made analyses of rocks and ores for the Wheeler Survey. At the Army Medical Museum, Doctors Craig and Mew examined drugs for the War Department. The Patent Office, of course, employed a staff of chemists, but they had no laboratory, and their functions were critical rather than productive. In addition, the government had just started a laboratory connected with the Custom House at New York, and maintained another at Brooklyn for the purposes of the Navy. At West Point and Annapolis, chemistry was taught as an incidental study, but not by laboratory methods; and at Newport one or two chemists were engaged in the torpedo service.

² Bull. 1, Chemical Society of Washington.

Professor Clarke then gave a brief account of the progress that had been made in the twelve years following the date mentioned.

At the present time, of the nine departments, only three have no chemical laboratories—the Department of State, the Department of Justice, and the Post-Office Department.

TREASURY DEPARTMENT

The laboratory of the supervising architect's office is charged with the examination of metals, alloys, cements and miscellaneous structural materials. Its work is largely of a routine nature resembling in a general way that of a railroad testing laboratory.

The division of chemistry of the Bureau of Internal Revenue is charged with the analysis of all samples submitted under internal revenue laws. These include the determination of alcohol in distilled beverages, the examination of remedies containing alcohol to determine whether their medicinal principles are sufficient to exempt them from internal revenue tax, the examination of oleomargarine and adulterated butter and of such samples of mixed flour and filled cheese as are taken in connection with the laws regarding the taxation of those products. The laboratory also examines supplies furnished other branches of the department under contract and supervises the work of subordinate laboratories at collectors' or agents' offices.

The scientific work of the Public Health and Marine Hospital Service is concentrated in the hygienic laboratory. The chemical division of this laboratory was organized in 1905. Its principal object is to cooperate with the other divisions of the laboratory in the solution of problems pertaining to the public health, and to undertake such routine chemical work as may be required by the United States

Public Health and Marine Hospital Service at large.

As illustrative of the scope of the laboratory may be mentioned the chemical study of the water from the several sources used for drinking purposes in the District of Columbia; the examination of drugs and of pathological specimens, such as urine, gastric contents, etc., and a number of biochemical studies particularly on subjects related to experimental medicine and pathology.

Chemical laboratories are maintained in connection with the offices of the United States Customs Appraisers at the ports of New York, Boston, Philadelphia, New Orleans, Chicago and San Francisco. With the exception of that at New York, the chief work of these laboratories is the polarization of sugar. At the present time a laboratory is also maintained at Kansas City for the assay of imported ores. Approximately, seventy per cent. of the importations of the entire country are entered at New York, and in addition to the analyses of such goods, many of the chemical problems of other ports are referred to the New York laboratory. Again, many shipments of exported goods, manufactured of imported materials under drawback regulations are examined.

The work of a customs laboratory covers a very wide range and includes all imported products in the classification and valuation of which the laboratory can assist.³ The examination required is usually superficial, frequently but a single determination being necessary. It is apparent that the work of such a laboratory is essentially routine, but that new problems requiring originality and resource must frequently arise.

NAVY

The Navy Department maintains laboratories at the Washington, New York, Bos-

ton, Norfolk and Mare Island Navy Yards, at the Newport Torpedo Station and the Naval Proving Ground at Indian Head, Maryland. At the Navy Yard laboratories a wide range of products is examined including steel, iron, all kinds of alloys entering into the construction of guns and carriages, and supplies needed in machine shops and on the boats of the Navy. These supplies include lubricating and other oils, coke and coal, rubber goods for different purposes, paints, cements and other building materials, water and office supplies.

INTERIOR DEPARTMENT

The chemical laboratory of the Geological Survey examines rocks, minerals, clays, ores, waters, coal, etc., for the purpose of assisting in the geological problems of the survey and to determine the extent of the diffusion of the elements in nature. In this laboratory many important researches of quite varied character are conducted.

The technical branch of the survey also maintains laboratories, especially at Pittsburgh, for the examination of coal and structural materials.

The water supply branch of the survey maintains a laboratory for the investigation of waters and has the cooperation of chemists at a number of points in the United States. Their work is largely the analysis of river waters in connection with irrigation problems, sanitary problems and the measurement of the amount of material removed from the soil by streams.

DEPARTMENT OF AGRICULTURE

Among the investigations now being conducted by the Bureau of Chemistry of the Department of Agriculture, the following may be mentioned: The study of the composition, character, and methods of manufacture and preservation of food, both from an economic standpoint and to de-

³ Moore, *Jour. Soc. Chem. Ind.*, 1900, 19, 323-4.

termine their influence upon nutrition and health; the inspection in connection with the enforcement of the federal food and drugs act, of foods and drugs sold in interstate commerce and in the District of Columbia and the territories; the study of the influence of environment upon the composition of agricultural products; the study of conditions relating to the several saccharine products such as syrup, molasses, sugar and honey; the chemical questions relating to the dairy industry; the effect of trade wastes on forests and agricultural products as, for instance, the effect of smelter fumes on vegetation and animals; the influence of chemical preservatives and colors on nutrition and health; the influence of cold storage preservation on the composition of foods; chemical-technical problems relating to the leather and paper industries; and certain studies in enological technology.

The functions of the bureau also include a wide range of routine work. In addition to the analyses of products coming naturally within the scope of the department of Agriculture, the bureau is especially authorized by congress to examine the supplies of other departments of the government such as foods for the Army, Navy and Panama Canal Commission; post-mark and cancelling inks, inking pads, glue, glycerin, soap, lubricating oils, and linoleum used by the Post-Office Department; disinfectants, lubricating oils and coals used by the government hospital for the insane; dry colors, oils, glue, soap, steel, and miscellaneous supplies used by the Bureau of Engraving and Printing; gums, oils, and alloys used by the Government Printing Office; writing inks, typewriter ribbons, carbon papers, etc., used in the various executive departments where permanence of records is essential; paints, oils, varnishes, chemical glassware and other apparatus used in the Department

of Agriculture, and assistance is occasionally given the Treasury Department in the examination of materials regarding which there has arisen a question as to classification for dutiable purposes.

For purposes of administration the bureau is divided into two divisions, seven laboratories and four sections in Washington, and sixteen food and drug inspection laboratories and two sections for special investigations are maintained in other cities.

The Biochemic Laboratory of the Bureau of Animal Industry is charged with the examination of stock dips and with other chemical studies relating to the work of the bureau. The work of the laboratory includes a large number of routine analyses for which branch laboratories are maintained in various parts of the United States. Much routine and research work connected with biochemical problems is also conducted.

The chief effort of the chemical laboratories of the Bureau of Soils has been the application of the methods of physical chemistry to the problems of the soil. The routine work of the laboratories includes the examination of soils, fertilizers and irrigation and drainage waters to meet the demands of the field forces of the bureau. The following investigations serve to illustrate the nature of the research work that has been done: The solubility of the mineral and organic components of the soil and the physical-chemical characteristics of the resulting solution; the study and practical application of the chemistry of alkali, common carbonates and gypsum, the reclamation and utilization of mine runnings and waste waters for irrigating purposes; and studies relating to humus, the iron compounds of the soil, absorption and toxicity.

The forest service of the Department of Agriculture maintains a chemical labora-

tory whose province it is to study the chemical composition of wood in all forms including studies on wood distillation, the analysis and standardization of timber preservatives, the estimation of the tannin and cellulose content of wood and bark, bleaching experiments, etc., and to conduct investigations covering the utilization of various woods and saw-mill waste for paper pulp and allied products. One of the important objects of this laboratory is to experiment on the pulp-making possibilities of various woods with a view to obtaining: First, a pulp with which it will be practicable to replace spruce pulp, the supply of which has notably diminished; second, other pulps that may have properties particularly adapted to the manufacture of special kinds of paper; third, a pulp of marketable value as a by-product from the waste material from saw mill and lumbering operations.

The Office of Experiment Stations of the Department of Agriculture does not maintain a laboratory but employs a number of men with chemical training in connection with the publication of the *Experiment Station Record* and other publications relating to chemical matters. The work of this office is of special interest because of its intimate connection with the forty-eight state agricultural experiment stations of the United States. Although these stations are in part maintained by funds appropriated by congress they are not under the supervision of the federal government, and for that reason can not receive more than a passing notice in this connection.

COMMERCE AND LABOR

The chemical laboratory of the Bureau of Standards has a considerable amount of routine work in the examination of supplies—chiefly for the Department of Commerce and Labor. Its principal work,

however, is of a research character including, among other lines, the preparation and examination of substances employed in the construction of standard electrical cells and the investigation of methods used in technical analysis and in the examination of chemical reagents for the purpose of improving their standards of purity.

I have stated briefly the aim and character of the work done in those government laboratories to which appointments are most frequently made, and have given as complete an idea as I could in the time at my disposal of the opportunity they offer for study and research.

Practically all appointments are made from the eligible lists of the Civil Service Commission. The only exceptions are those of chemists whose training and experience peculiarly qualifies them to undertake some special problems and whose appointments are temporary. The examinations from which such eligible lists are established may be broadly divided into four classes.

1. *Those occasioned by vacancies in positions of unusual responsibility or requiring exceptional training and experience.* Examinations of this type are frequently "non-assembled" and no practical questions are asked. Applicants are rated on the courses of study they have completed and especially on the work they have done. The degree of doctor of philosophy or its equivalent is commonly essential to eligible rating in educational requirements. Under educational qualifications it is obvious that only that work can be recognized for which credit has been received from reputable colleges or universities. Unfortunate as it may be, it is impossible to rate statements of applicants regarding independent study or regarding partial courses in educational institutions from which no credit has been received. Experience is rated, especially in the case of younger men, on

the basis of work done under the direction of, or in connection with, experienced chemists, and in laboratories of known reputation. The fragmentary work of teachers who, immediately after their graduation, are thrown upon their own resources and make occasional investigations or analyses in their spare time, can not be rated in an examination unless its value can be demonstrated by the applicant by means of references to publications or otherwise. Such experience is not to be compared with that of chemists whose entire time is devoted to research or analytical work and whose chief effort is given to the study of new problems, the economy of time, the increase of the volume and accuracy of their work, and the improvement of their laboratory technique.

Emphasis is frequently placed on the original contributions applicants have made to scientific literature, which serves as a measure of their ability to meet new conditions and to report the results of their investigations. The evidence they produce of executive ability is rated and their experience in the particular line for which the examination is given. This type of examination gives the most satisfactory results, and is usually given to fill positions paying a salary of \$2,000 or more.

2. *Examinations for experienced and skilled analysts.* In such examination are rated the educational qualifications of the candidates and their experience, particularly in analytical chemistry. Education and experience are usually rated together.

Practical questions are also given in examinations of this type. The questions are chosen with a view to affording a fair test for chemists who have been in practical work for a number of years and to include fundamental principles and methods. The statement is frequently made that examinations place experienced chemists at a disadvantage as compared with recent

graduates. While this is true, to a certain extent, the questions given in this type of examination call for a familiarity with analytical chemistry which is rarely acquired by the student and are of a type that any efficient analytical chemist should be able to answer. Moreover, the emphasis placed on education and experience when rating these papers is sufficient to make it practically impossible for a graduate who has not had analytical experience to obtain an eligible rating. The degree of bachelor of science or its equivalent and post-graduate study or practical experience are usually necessary to obtain eligible rating. A special course, incomplete in itself or not preceded by the full training of the secondary schools, will not answer. A mark of seventy per cent. in education and experience is often required for admission to examinations of this type. In such cases a statement of that fact is made in the published announcements. Even when such requirement is not made, the rating given for a degree following a course of two or even three years is so low that such an applicant must make an unusual showing in his replies to the practical questions to obtain an eligible rating in this examination. An application is useless from one whose only collegiate training was a two or three year course, the entrance requirements of which are inferior to those of reputable institutions giving the degree of bachelor of science.

The applicants who stand among the first on the eligible list established by an examination of this type are commonly paid a salary of from \$1,400 to \$1,800. Other appointments at a lower salary are also frequently made from the same lists.

3. *Examinations to establish an eligible list from which subordinate appointments may be made.* These examinations are given for the purpose of affording an opportunity to recent graduates in chemistry

whose practical experience has been limited. Those who have had practical experience of course receive a higher rating in education and experience, but a passing mark in education and experience is given for a degree of Bachelor of Science or its equivalent from a creditable institution giving a course in chemistry of approximately three years with nine recitation hours a week—three laboratory hours being equivalent to one recitation hour. A higher rating is given those who have had postgraduate experience. In this class of examinations an eligible rating in education and experience is not required, but a low rating in that subject may be compensated by a high mark in practical questions. The practical questions asked in these examinations are of a different character from those of the second class, and it is believed that they are better adapted to the class of chemists for whom they are intended. It is from the eligible list established by this examination that the great mass of appointments to subordinate positions in the various laboratories is made. The salaries paid usually range from \$840 to \$1,200 per annum.

4. *Examinations for analysts qualified in a special (sometimes narrow) field of work.* Examinations of this class are relatively infrequent and are held for the purpose of supplying needs that sometimes arise in some of the laboratories of the government service for men competent to perform analytical work in some narrow field, but whose services in other branches of chemistry will not be required. The eligible lists so created are not commonly used for appointments in other branches of the service.

It must not be understood that there is a definite system of examinations and that each examination is made to fit into one of the types given above. An examination is usually called to fill a particular va-

cancy, although it is understood that after that vacancy is filled the list may be used to make other appointments for which the same or lower qualifications are required in the same or other departments. It would not be within the civil service rules, however, to appoint an assistant to the laboratory of the supervising architect's office who has passed an examination calling for widely different qualifications; for instance, an examination in dairy chemistry.

Transfer from one laboratory to another within the same department is possible at any time when the good of the service does not suffer thereby. Such transfers are sometimes made but are rather unusual. Transfers from one department to another are unusual and can not be made within three years of the date of appointment.

Examinations for chemical positions are not given regularly as is true of examination for clerks. They are given at irregular intervals as need arises, sometimes as many as six or eight chemical examinations of various character occurring in a single year. The civil service commission publishes an announcement of each examination and sends it to all applicants. These announcements are also sent to educational institutions throughout the country. They are also published in SCIENCE. No information regarding examinations is given except that stated on the announcement just mentioned. No definite information is given regarding the character of the questions that will be asked. No copies of questions asked in former examinations are supplied. No information can be given out by the laboratory for which the examination is called other than that contained in the published civil service announcement. It is held that variation from this principle would give an unfair advantage to those who happen to receive it. It is believed that the class of men de-

sired are able to pass the examinations without special preparation, and it is not desired to afford any particular opportunity for such preparation.

With the exception of a few small laboratories where the field work is limited and promotion is not offered, the great majority of appointments to the various government laboratories are to subordinate positions and higher positions are filled by promotion whenever possible. Special qualifications are, therefore, not usually required.

I wish to emphasize the fact that every appointee should have pursued a broad general course of study. The argument is frequently made, and it is doubtless true, that the work for which the majority of appointments are primarily made, that is, the ordinary routine work of the laboratory, could be as well performed at the beginning by men who are not college graduates, and frequently by men whose training in chemistry itself has been very incomplete. It is found, however, that while such men may be satisfactory at the beginning, their potential power is limited. Men with special training are frequently desired for the purpose of conducting special investigations. This special training, however, should have been received in post-graduate study. The ability to conduct research work that is constantly required, the resource essential to emergencies and even the initiative required by those who take a responsible part in the routine work of the laboratory are rarely secured except in men with broad fundamental training.

W. D. BIGELOW

THE AMERICAN SOCIETY OF ZOOLOGISTS

II.

A Comparison of the Cephalic Organs in Certain Sipunculids: JOHN H. GEROULD, Dartmouth College.

A comparison was made between the

cephalic organs in *Phascolosoma verrillii*—an undescribed species from Vineyard Sound and Buzzards Bay, covered with prominent papillæ and characterized by having only a single pair of retractor muscles (ventral)—and the corresponding organs in *Sipunculus nudus* and in other forms.

P. verrillii has not only the ciliated nuchal organ of other *Phascolosomas* (*P. gouldii*, *P. vulgare*) but also a cerebral organ, that lies superficially between the nuchal organ and the mouth. In a young (postlarval) individual it forms a rounded elevation of surface epithelium dorsal to the mouth, but ventral, or oral, to the nuchal organ. In the adult (*P. verrillii*, *P. gouldii*) it becomes less conspicuous and elongated transversely in the frontal plane. It is closely connected with the brain (supra-esophageal ganglion) by a pair of large lateral cords containing (1) a pair of ocular tubes, which open dorso-laterally upon the surface of the cerebral organ, and (2), mesial to each ocular tube, the special neurones and a pair of sensory pits of the cerebral organ itself.

The cerebral organ in *Sipunculus nudus*, as Ward and, later, Metchnikoff have shown, projects into the bottom of a long tube which, opening upon the dorsal surface of the body slightly behind the tentacles, runs backward and inward to the cerebral organ. The latter and the corresponding organ upon the surface of the head in *Phascolosoma* have precisely similar relations to the brain; and ocular tubes open upon the surface of the cerebral organ in both forms. *Phymosoma* (*Physcosoma*) *varians*, as described by Shipley, shows an intermediate stage between the primitive condition in *Phascolosoma*, in which the cerebral organ is superficial, and that in *Sipunculus*.

Ocular tubes with pigmented walls were found in a specimen of *Sipunculus nudus*